

over-ambitious amateur runners, rather than elite runners, are placed at the rising slope of the U-shaped relationship between jogging dose and all-cause mortality. Therefore, novice and amateur runners could not only optimize their running training and performance but also their cardiovascular health by following modern training methods used by elite runners.

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<http://dx.doi.org/10.1016/j.jacc.2015.02.078>

Please note: Both authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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Sex, Jogging, and Mortality



The Copenhagen City Heart Study

We read with great interest both the paper by Schnohr et al. (1) on the dose of jogging and mortality in the CCHS (Copenhagen City Heart Study) cohort and the editorial comment by Lee et al. (2). There is one major confounder in the original paper we would like to emphasize: sedentary nonjoggers were more often women (57%) and strenuous joggers were mostly men (80%). This unbalance is of utmost importance for mortality studies because the men-women life expectancy difference at 44 years (mean baseline age in the CCHS) was -3.9 years in Denmark in 2001 (Eurostat). In a previous paper, the same Danish team reported that jogging could increase survival by 6.2 years in men and 5.6 years in women (3). Therefore, the effect of sex on the outcome (mortality) is of the same order of magnitude as the effect of the variable of interest

(jogging). The only reasonable approach in that case is to analyze men and women in 2 separate studies. There is no need to use statistics to test the hypothesis of an effect of sex on mortality, because this effect is not a hypothesis but a fact. Pooling men and women together and adjusting by sex can only decrease the power of the analyses and fails to show a potential difference between sedentary nonjoggers and strenuous joggers. A simple rule of thumb calculation with the previously described estimates of both sex and jogging effects shows that, compared with a putative all-men sedentary nonjogger group of the same age, the sedentary nonjogger and strenuous jogger groups of the CCHS would have an increased life expectancy of 4.2 and 3 years, respectively, which could mistakenly be interpreted as an increased risk for the strenuous joggers. Therefore, we strongly recommend men and women being considered separately when conducting mortality studies.

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<http://dx.doi.org/10.1016/j.jacc.2015.03.589>

Please note: Both authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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Dose of Jogging

Mortality Versus Longevity



We read, with great interest, the paper by Schnohr et al. (1), who investigated the association between jogging and long-term all-cause mortality. The investigators reported that light and moderate joggers had lower mortality rates (hazard ratio [HR]: 0.22; 95% confidence intervals [CI]: 0.10 to 0.47 and HR: 0.66; 95% CI: 0.32 to 1.38, respectively) compared

with sedentary nonjoggers, whereas these health benefits were absent in strenuous joggers (HR: 1.97; CI: 0.48 to 8.14). Hence, the investigators concluded that a U-shaped association between exercise dose and all-cause mortality was present, which suggested an upper limit of the health benefits of exercise.

Interestingly, strenuous exercise was established as >4 h of jogging per week at a fast pace. Although this amount of physical activity clearly exceeded the current exercise recommendations, these doses were typically observed in amateur and professional athletes. Other studies investigated the life expectancy of athletic populations. Finnish skiers (2) and world-class endurance athletes (3) demonstrated an increased life expectancy of 2.8 to 6 years compared with reference cohorts. A study that included 15,174 Olympic medallists confirmed these findings, and found 2.8 years of increased life expectancy compared with matched cohorts from the general population (4). Furthermore, a large Swedish study reported a 52% reduction of all-cause mortality among participants of the Vasaloppet cross-country ski-race, with the highest life expectancy found in older participants and athletes who participated in multiple races (5).

These findings suggest that high volumes of exercise training improve longevity and are in contradiction to the U-shaped association between exercise dose and all-cause mortality as suggested by Schnohr et al (1). The small sample size of the strenuous jogger group (n = 40), with only 2 deaths during the 12 years of follow-up, may contribute to these conflicting findings. In addition, the lack of insight into the cause of death may confound the results; if only 1 of the 2 death cases was caused by a non-natural death (e.g., accidents, suicide), the study outcomes would be completely different. Finally, the arbitrarily chosen cutpoints for classification of the light, moderate, and strenuous jogger groups may not appropriately reflect the spectrum of light to extreme doses of exercise training.

Therefore, we believe, that the evidence for an upper limit (>4 h/week) of exercise health benefits and associated all-cause mortality is premature. With physical inactivity as 1 of the most influential risk factors for worldwide morbidity and mortality, we would recommend to keep on running.

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Please note: The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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Strenuous Exercise Worse Than Sedentarism?



Schnohr et al. (1) reported a U-shaped association between all-cause mortality and exercise dose in a Danish cohort. Jogging 1 to 2.4 h/week was associated with the lowest mortality, whereas jogging >3 times/week was no better than being inactive and was worse than light jogging (adjusted hazard ratio [HR]: 9.08; 95% confidence interval [CI]: 1.87 to 44.01). Furthermore, older (61.3 ± 16.2 years) sedentary nonjoggers with cardiovascular disease (CVD) risk factors (high body mass index, high blood pressure, smoking, and diabetes) had even lower mortality rates than younger (37 ± 13.9 years) intense joggers without these risk factors (adjusted HR: 1.97; 95% CI: 0.48 to 8.14) (1). Besides challenging well-established medical knowledge (i.e., that physical inactivity is a risk factor for CVD), the notion that high exercise doses might be worse than sedentarism for health in a specific cohort could lead to misinterpretations and erroneous generalizations. For example, the press in Spain recently also suggested a “killing” effect of “too much exercise.” However, among 10.9 million U.S. individuals who ran in marathons from 2000 to 2010, only 59 experienced cardiac arrest/sudden death,